

NEC[®]**NPN MEDIUM POWER
MICROWAVE TRANSISTOR****NE33300
NE33353E
NE33353B
NE33387**

T-33-05

FEATURES

- **450 mW LINEAR POWER OUTPUT**
at 2 GHz (Common-Emitter)
- **1.25 W CLASS C POWER OUTPUT**
with 8.0 dB Gain at 3 GHz (Common-Base)
- **0.35 W OSCILLATOR POWER OUTPUT**
at 5 GHz (Common-Collector)
- **RUGGED HERMETIC STRIPLINE PACKAGES**

DESCRIPTION AND APPLICATIONS

The NE333 series of NPN silicon transistors is designed for L and S-Band medium power applications. The series is available in either chip form or in a variety of metal-ceramic packages. The series employs silicon nitride (Si₃N₄) passivation, silicon dioxide (SiO₂) glassivation and NEC's proprietary fabrication technique which uses arsenic doped polysilicon (AsDOPOS). The NE33353 is available in common-emitter and common-base configurations. The NE33387 in a common-collector configuration is ideally suited for oscillator applications. Reliability is assured by NEC's titanium-platinum-gold metallization system and stringent production controls patterned after MIL-S-19500.

PERFORMANCE SPECIFICATIONS (T_A = 25°C)

PART NUMBER PACKAGE OUTLINE			NE33300 00 (CHIP)			NE33353B 53B			NE33353E 53E			NE33387 87		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
f _r	Gain Bandwidth Product at at V _{CE} = 10 V, I _c = 100 mA	GHz	3.0	4.5		3.0	4.5		3.0	4.5		3.0	4.5	
S _{21E} ²	Insertion Power Gain at V _{CE} = 10 V, I _c = 100 mA, f = 2 GHz	dB		5.0						5.0				
MAG	Maximum Available Power Gain* at V _{CE} = 10 V, I _c = 100 mA, f = 1 GHz f = 2 GHz f = 4 GHz	dB dB dB		16.0 10.5 4.0						16.0 10.5 4.0				
P _{OUT}	Class C Power Output at V _{CC} = 11 V, P _{IN} = 22 dBm, R _E = 0.7 Ω, f = 3 GHz	W					1.25							
P _{osc}	Power Output as an Oscillator at V _{CE} = 11 V, I _c = 140 mA, f = 5 GHz	mW											355	
P _{1dB}	Power Output at 1 dB Compression, V _{CE} = 10 V, I _c = 100 mA, f = 2 GHz	mW		450						450				

*Maximum Available Gain (MAG) is calculated from the device S-Parameters using the equation,

$$\text{MAG} = \frac{|S_{21}|}{|S_{12}|} (K \pm \sqrt{K^2 - 1}) \quad K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2|S_{21}||S_{12}|} \quad \Delta = S_{11}S_{22} - S_{21}S_{12}$$

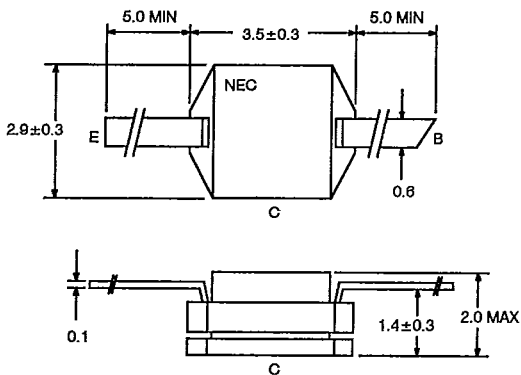
ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

PART NUMBER PACKAGE OUTLINE			NE33300 00 (CHIP)			NE33353B 53B			NE33353E 53E			NE33387 87		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX
I_{CBO}	Collector Cutoff Current at $V_{CB} = 10\text{ V}$, $I_E = 0$	μA			0.5			0.5			0.5			0.5
I_{EBO}	Emitter Cutoff Current at $V_{EB} = 2\text{ V}$	μA			0.5			0.5			0.5			0.5
h_{FE}	Forward Current Gain at $V_{CE} = 6\text{ V}$, $I_C = 100\text{ mA}$ (pulsed)		20	40	200	20	40	200	20	40	200	20	40	200
C_{CB}^*	Collector to Base Capacitance at $V_{CB} = 10\text{ V}$, $I_E = 0$, $f = 1\text{ MHz}$	pF		1.0	1.5		2.6	3.5		1.0	1.5		1.4	2.0
R_{TH}	Thermal Resistance (Junction-to-Case)	$^\circ\text{C/W}$			35			35			35			35
P_T	Total Power Dissipation	W			5.0			5.0			5.0			5.0

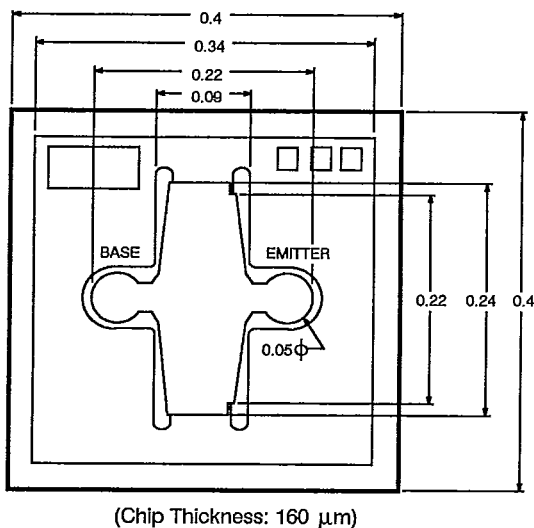
* C_{CB} measurement employs a three-terminal capacitance bridge incorporating a guard circuit. The emitter terminal shall be connected to the guard terminal.

OUTLINE DIMENSIONS (Units in mm)

OUTLINE 87



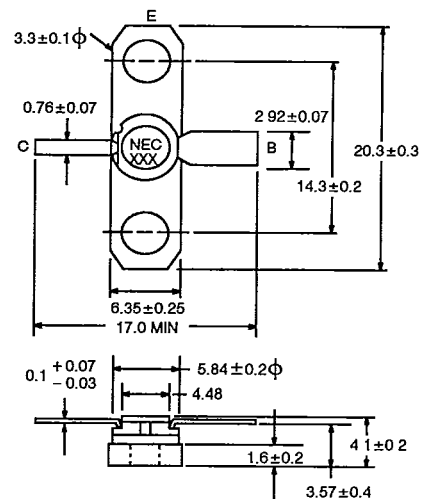
NE33300 (CHIP)


ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$)

SYMBOLS	PARAMETERS	UNITS	RATINGS
V_{CBO}	Collector to Base Voltage	V	28
V_{CEO}	Collector to Emitter Voltage	V	14*
V_{EBO}	Emitter to Base Voltage	V	3.0
I_C	Collector Current	mA	200
T_J	Junction Temperature	$^\circ\text{C}$	200
T_{STG}	Storage Temperature	$^\circ\text{C}$	-65 to +200

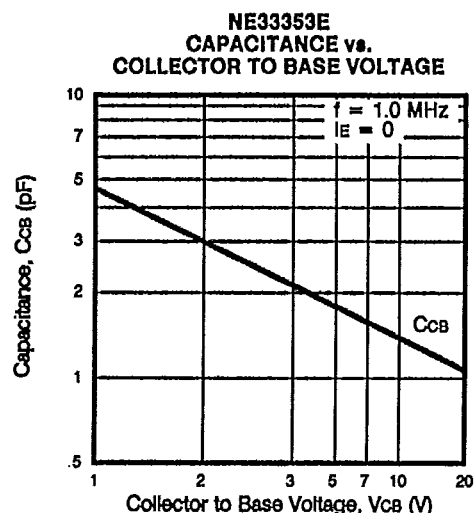
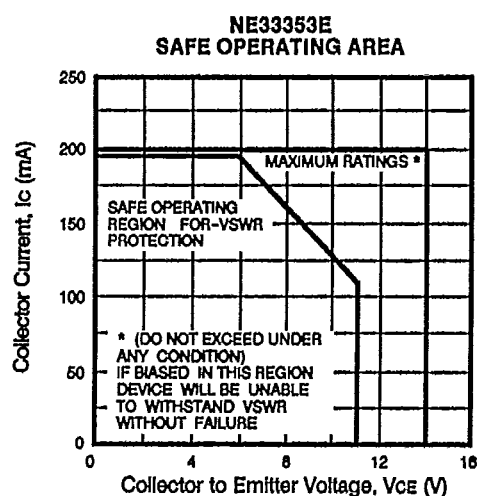
*Typical $V_{CER} = 30\text{ V}$ for $R \leq 300\ \Omega$

OUTLINE 53 E/B*

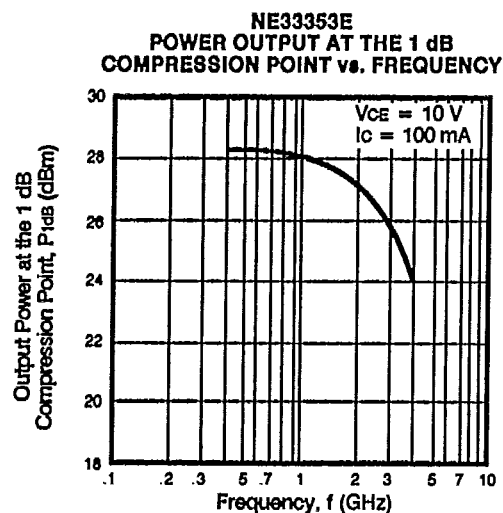
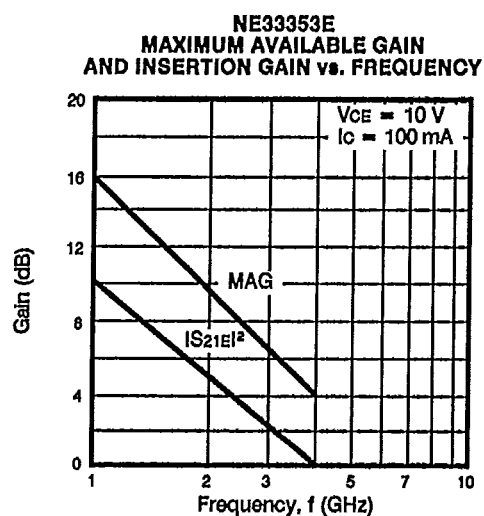


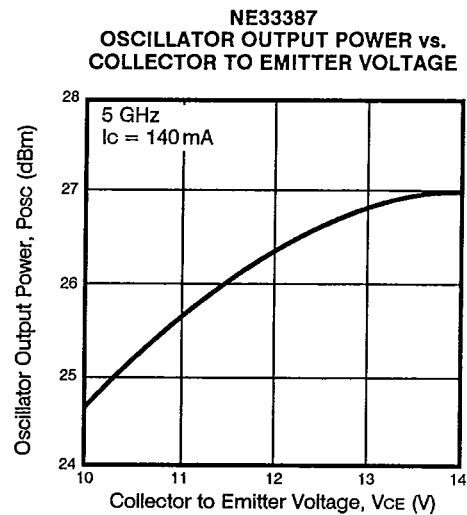
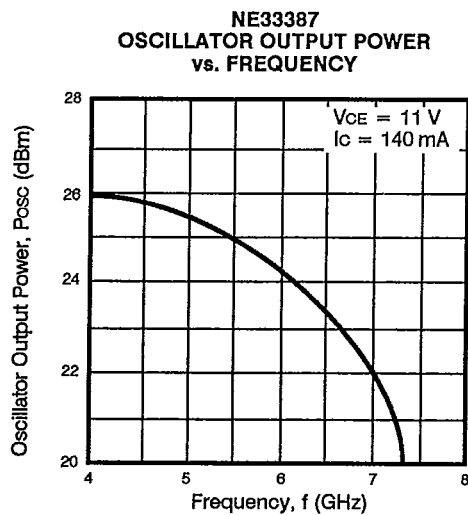
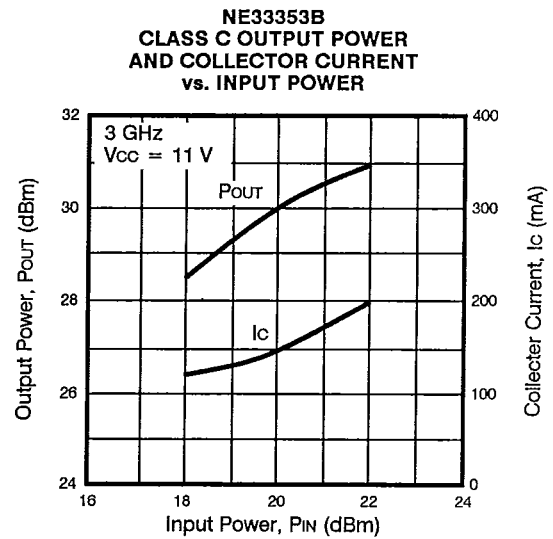
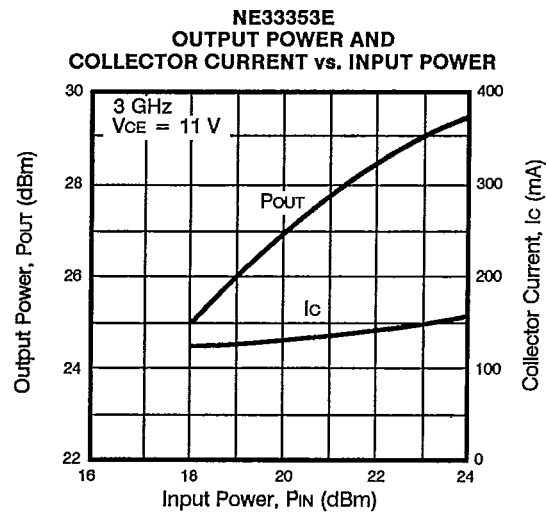
*53B has emitter and base reversed.

TYPICAL DEVICE CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

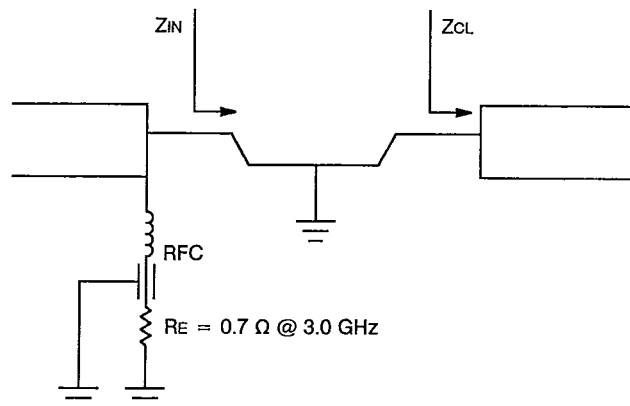
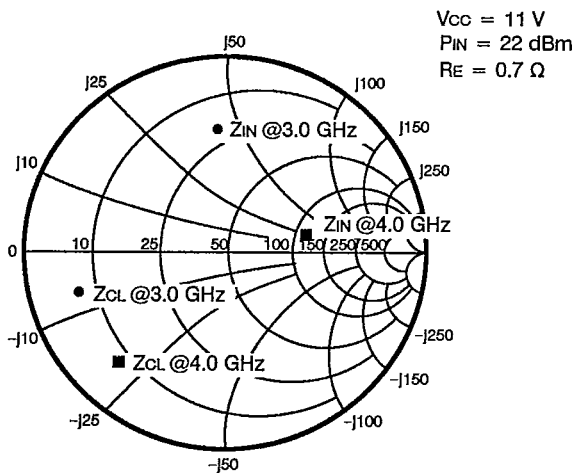


TYPICAL PERFORMANCE CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

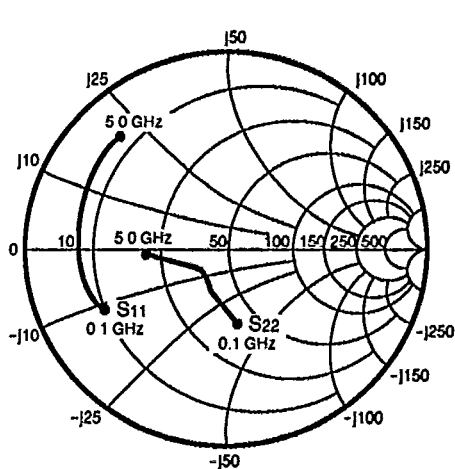


TYPICAL PERFORMANCE CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

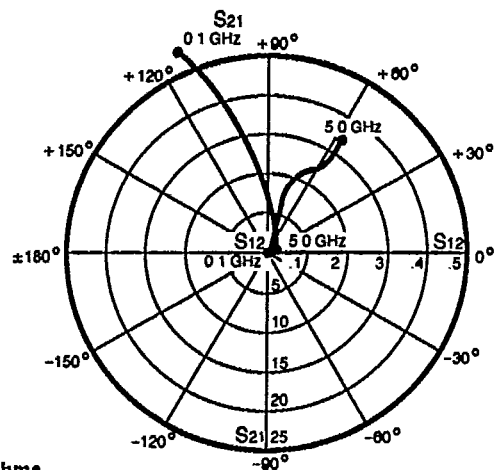
NE33353B IMPEDANCE CHARACTERISTICS



TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE33300
Coordinates In Ohms
Frequency In GHz
(V_{CE} = 10 V, I_C = 100 mA)



S-MAGN AND ANGLES:

V_{CE} = 10 V, I_C = 50 mA

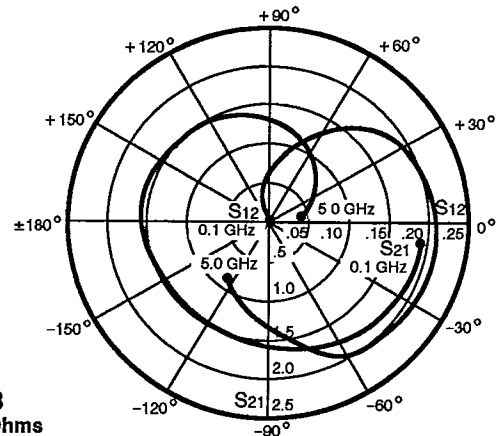
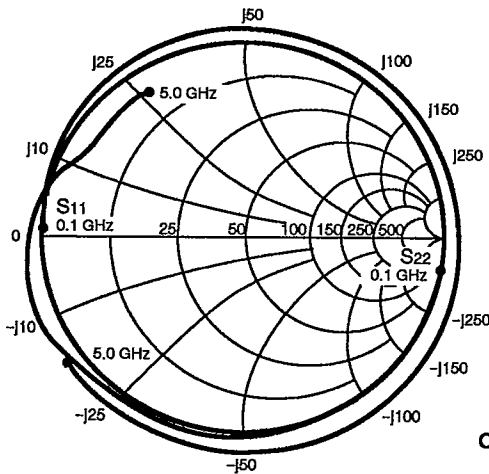
FREQUENCY (MHz)

	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	0.65	-146	26.98	118	0.01	66	0.47	-70
200	0.70	-164	14.87	103	0.01	43	0.30	-92
300	0.72	-171	10.15	96	0.02	57	0.23	-108
400	0.73	-175	7.62	91	0.03	62	0.21	-122
500	0.74	-178	6.14	88	0.04	62	0.20	-129
600	0.73	180	5.14	85	0.04	66	0.19	-137
700	0.73	176	4.43	82	0.05	68	0.18	-137
800	0.73	176	3.80	80	0.06	70	0.20	-137
900	0.75	175	3.41	78	0.07	68	0.20	-143
1000	0.74	172	3.07	76	0.07	72	0.19	-144
2000	0.74	161	1.57	59	0.13	73	0.24	-150
3000	0.78	151	1.11	47	0.21	69	0.32	-168
4000	0.79	134	0.90	30	0.28	58	0.40	-173
5000	0.77	133	0.74	30	0.34	58	0.39	-177

V_{CE} = 10 V, I_C = 100 mA

	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
100	0.67	-154	28.19	113	0.01	65	0.41	-79
200	0.71	-168	15.05	100	0.01	48	0.26	-101
300	0.72	-173	10.19	93	0.02	62	0.21	-118
400	0.73	-177	7.62	89	0.03	66	0.19	-131
500	0.74	-179	6.13	87	0.04	66	0.18	-136
600	0.73	178	5.12	84	0.04	68	0.18	-145
700	0.74	177	4.41	81	0.05	71	0.18	-142
800	0.73	175	3.77	79	0.06	73	0.19	-141
900	0.75	174	3.39	78	0.07	72	0.19	-148
1000	0.74	171	3.06	75	0.07	74	0.19	-149
2000	0.74	161	1.57	58	0.14	74	0.24	-153
3000	0.78	150	1.13	47	0.22	68	0.32	-173
4000	0.80	134	0.91	30	0.29	57	0.39	-177
5000	0.77	133	0.75	29	0.34	57	0.38	-180

TYPICAL COMMON BASE SCATTERING PARAMETERS



S-MAGN AND ANGLES:

VCB = 11 V, IC = 100 mA

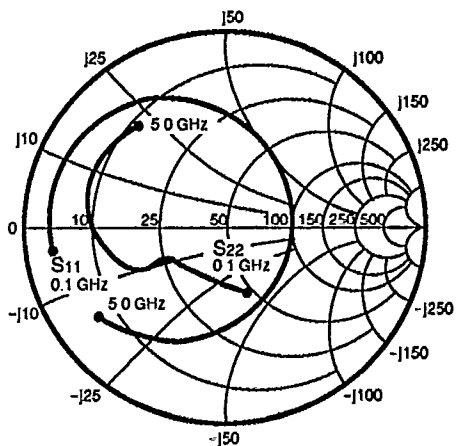
FREQUENCY (MHz)

	S11		S21		S12		S22
100	0.98	178	1.93	-8	0.01	122	1.01
200	0.98	176	1.92	-13	0.01	147	0.99
300	1.00	174	1.87	-22	0.01	129	1.02
400	0.99	172	1.90	-28	0.01	137	1.00
500	1.00	170	1.87	-35	0.01	106	1.01
600	1.00	167	1.81	-41	0.02	128	1.02
700	1.00	165	1.81	-49	0.01	115	1.02
800	0.99	164	1.78	-51	0.02	133	1.03
900	1.00	162	1.73	-59	0.02	115	1.04
1000	1.01	159	1.69	-65	0.02	124	1.03
2000	1.07	130	1.50	-120	0.09	81	1.06
3000	1.12	68	1.63	178	0.19	37	1.10
4000	1.18	-58	1.25	81	0.21	-52	0.85
5000	1.09	-142	0.43	5	0.08	-127	0.87

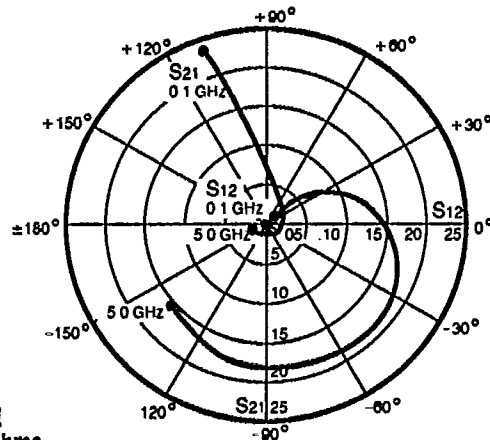
VCB = 11 V, IC = 150 mA

	S11		S21		S12		S22
100	0.97	177	1.82	-11	0.01	65	0.98
200	0.97	175	1.77	-18	0.01	60	0.96
300	0.99	173	1.68	-28	0.01	74	0.99
400	0.97	171	1.68	-34	0.01	81	0.95
500	0.98	170	1.64	-41	0.01	89	0.96
600	0.97	167	1.56	-47	0.02	78	0.97
700	0.99	165	1.55	-56	0.01	97	0.98
800	0.98	163	1.51	-60	0.02	105	0.98
900	0.99	160	1.44	-67	0.02	99	0.99
1000	0.98	158	1.39	-74	0.02	101	0.98
2000	0.99	129	1.13	-133	0.07	76	0.99
3000	0.97	65	1.16	158	0.17	28	0.99
4000	1.01	-62	0.82	61	0.17	-53	0.80
5000	1.03	-144	0.26	-16	0.09	-135	0.85

TYPICAL COMMON EMITTER SCATTERING PARAMETERS



NE33353E
Coordinates in Ohms
Frequency in GHz
(VCE = 10 V, IC = 150 mA)



S-MAGN AND ANGLES:

VCE = 10 V, IC = 50 mA

FREQUENCY (MHz)

	S11		S21		S12		S22	
100	.76	-154	27.04	115	.02	50	.48	-83
500	.85	176	6.58	78	.02	40	.29	-141
1000	.84	164	3.41	57	.03	51	.30	-148
1500	.81	153	2.40	38	.05	44	.35	-147
2000	.74	135	1.96	19	.08	33	.37	-147
2500	.67	118	1.75	-2	.11	19	.42	-151
3000	.54	91	1.64	-26	.14	-0	.49	-158
3500	.36	43	1.51	-56	.16	-26	.54	-167
4000	.34	-48	1.32	-91	.18	-61	.64	175
4500	.57	-111	.99	-129	.17	-101	.70	152
5000	.75	-147	.66	-161	.16	-139	.68	129

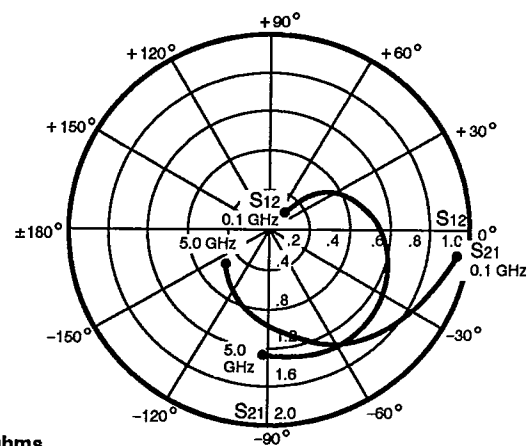
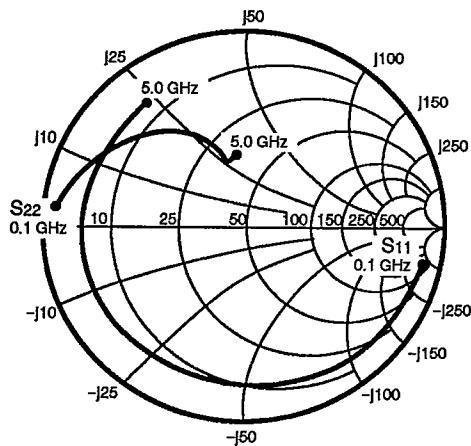
VCE = 10 V, IC = 100 mA

	S11		S21		S12		S22	
100	.80	-163	26.94	111	.02	57	.44	-94
500	.85	174	6.83	77	.02	53	.30	-149
1000	.83	162	3.55	57	.03	57	.30	-155
1500	.81	152	2.51	39	.06	44	.33	-153
2000	.73	134	2.05	20	.09	35	.35	-151
2500	.66	116	1.84	-1	.12	21	.39	-153
3000	.53	90	1.72	-27	.15	0	.45	-156
3500	.35	41	1.58	-55	.18	-27	.55	-166
4000	.34	-51	1.38	-92	.19	-62	.63	175
4500	.57	-112	1.03	-129	.17	-103	.68	152
5000	.75	-148	.69	-161	.16	-140	.66	128

VCE = 10 V, IC = 150 mA

	S11		S21		S12		S22	
100	.82	-169	23.07	109	.02	52	.35	-71
500	.85	173	5.47	80	.02	55	.28	-122
1000	.84	162	2.94	58	.03	56	.33	-136
1500	.82	151	2.09	39	.05	41	.38	-142
2000	.75	134	1.75	19	.09	37	.39	-146
2500	.69	116	1.56	-3	.11	22	.44	-151
3000	.56	89	1.46	-28	.14	1	.49	-156
3500	.39	40	1.35	-57	.17	-24	.58	-167
4000	.38	-47	1.18	-94	.18	-60	.65	174
4500	.59	-109	.89	-132	.17	-102	.69	152
5000	.76	-146	.59	-165	.15	-140	.67	129

TYPICAL COMMON COLLECTOR SCATTERING PARAMETERS



NE33387
Coordinates in Ohms
Frequency in GHz
($V_{EC} = -11$ V, $I_C = 140$ mA)

S-MAGN AND ANGLES:

VEC = -11 V, $I_C = 50$ mA

FREQUENCY (MHz)

	S11	S21	S12	S22
100	.96 -7	1.90 -5	.02 46	.94 176
500	.95 -36	1.82 -23	.19 58	.94 161
1000	.96 -69	1.70 -41	.34 38	.86 146
1500	.91 -97	1.52 -61	.44 21	.70 131
2000	.89 -124	1.37 -73	.52 2	.61 118
2500	.86 -146	1.17 -89	.56 -11	.54 109
3000	.87 -165	1.07 -100	.60 -28	.48 103
3500	.86 176	.94 -114	.61 -43	.43 96
4000	.87 160	.86 -123	.62 -56	.39 92
4500	.85 144	.74 -136	.61 -69	.37 89
5000	.86 128	.68 -145	.60 -82	.37 87

VEC = -11 V, $I_C = 100$ mA

	S11	S21	S12	S22
100	.97 -7	1.91 -5	.02 47	.95 176
500	.96 -36	1.83 -24	.19 58	.95 161
1000	.96 -70	1.71 -42	.34 38	.87 145
1500	.91 -98	1.52 -62	.45 22	.70 129
2000	.89 -123	1.36 -73	.52 3	.63 116
2500	.87 -145	1.16 -89	.56 -11	.54 107
3000	.87 -164	1.05 -100	.60 -28	.48 101
3500	.86 178	.92 -114	.62 -42	.43 93
4000	.87 161	.84 -123	.63 -56	.39 90
4500	.85 146	.73 -136	.61 -69	.37 87
5000	.85 131	.66 -145	.61 -82	.37 85

VEC = -11 V, $I_C = 140$ mA

	S11	S21	S12	S22
100	.92 -11	1.85 -8	.11 48	.90 173
500	.84 -43	1.68 -26	.30 38	.82 156
1000	.83 -79	1.51 -44	.44 21	.71 141
1500	.77 -107	1.31 -63	.54 6	.55 127
2000	.79 -132	1.19 -73	.58 -9	.49 117
2500	.76 -154	1.00 -87	.62 -22	.42 110
3000	.77 -172	.91 -98	.64 -38	.38 108
3500	.77 171	.80 -110	.65 -52	.34 104
4000	.78 155	.74 -118	.65 -64	.33 103
4500	.77 141	.65 -129	.63 -77	.34 102
5000	.77 126	.59 -138	.63 -90	.36 99